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ROHAULT AREA, ABITBI-EAST AND ROBERVAL ELECTORAL DISTRICTS

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GEOLOGICAL SURVEYS BRANCH

GEOLOGICAL REPORT 86

ROHAULT AREA

ABITIBI-EAST AND ROBERVAL

ELECTORAL DISTRICTS

by

J.-E. Gilbert

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ROHAULT AREA

ABITIBI-EAST AND ROBERVAL ELECTORAL DISTRICTS

by
J.E. GILBERT

INTRODUCTION

The Rohault area, comprising 195 square miles, is bounded by latitudes 49°15' and 49°30' and longitudes 74°15' and 74°30'. The centre of the area is about 25 miles almost due south of Lake Chibougamau and 110 miles northwest of Lake St.Jean. It includes most of Rohault township; the northern two-thirds of Robert; narrow strips of Crisafy, Gamache, and La Dauversière townships; and the southeastern corner of Fancamp township.

The Rohault area was geologically mapped by the writer during the summer of 1951. Particular interest attaches to this area because it is crossed by the contact zone between Keewatin-type and Grenville-type rocks. Discoveries of metallic minerals made in 1949 and 1950 along and close to the Rohault-La Dauversière line add some economic interest.

Access

The area is shortly to the southeast of the historic canoe route from Lake St. Jean to Lake Chibougamau. This route is described in the report of the Chibougamau Mining Commission (Barlow, Gwillim, and Faribault, 1911). Another canoe route, linking Lake Chibougamau to Oskelaneo, on the Quebec-Cochrane line of the Canadian National Railways, crosses the northwestern part of the area.

The St.Félicien-Chibougamau highway, completed in 1950, passes about 4 miles east of the northeastern corner of the area. A branch road at Mileage 121.0 provides easy access to the Chibougamau Explorers, Limited, property on Norhart lake, in the northwest. Rohault lake is accessible by canoe through Bouteroue (Owen) lake and its outlet river from Ducharme (Nicabau) lake. The southern extremity of Ducharme lake is connected to the St. Félicien-Chibougamau highway at Mileage

96.6 by a Canadian International Pulp and Paper Company road.

Aeroplane transportation to the area is provided by a number of companies from bases in the Chibougamau, Lake St. Jean, and Abitibi regions. Rohault, Némenjiche, Gabriel, and Norhart lakes provide good landing surfaces at any period of the year. Robert and Mannard lakes, although large, are in places very shallow, making hydroplane landings somewhat hazardous during periods of low water.

Large lakes and good portages make travelling within the area relatively easy. An exception is the portage between Némenjiche and Rohault lakes, which crosses a wide tract of soft ground. Also, the upper stretch of Némenjiche river has numerous rapids, two of which must be avoided by portaging. The outlet of Mannard lake is not navigable.

Recently cut survey lines provide access to parts away from the lakes. Windfalls and underbrush make travel through the bush generally difficult, except north of Rohault and Némenjiche lakes.

Field-work and Acknowledgements

Base maps at the scale of half a mile to the inch were provided by the Draughting and Cartography Branch of the Quebec Department of Mines. Vertical aerial photographs at the scale of approximately 1,000 feet to the inch, supplied by the Quebec Department of Lands and Forests, were used to add supplementary details to the base maps and to pinpoint various features of the area.

All rock exposures along the accessible lakes and the navigable streams were examined. Pace-and-compass traverses were run systematically in the intervening ground.

The writer was ably assisted in the field by H. Bruce Lyall, a graduate student, and Gerald W. Grant and George W. Mannard, all of McGill University. Lionel A. Jacob and Télesphore Cauchon, canoeman and cook respectively, also performed their duties in a very commendable manner.

Previous Work

The geology of the area was little known prior to the present investigation. In 1918, H.C. Cooke (1919, pp. 180-213) visited the shores of some of the larger lakes in the area, and the results of

his investigation are included on the Chibougamau Sheet, East-Half (Mawdsley and Norman, 1938) of the Geological Survey of Canada. Immediately adjacent areas have been mapped by the Quebec Department of Mines as follows: Queylus Area to the north (Imbault, 1951), Gamache Area to the west (Grenier, 1953), and Ducharme-Bouteroue Area to the east (Laurin, 1955).

DESCRIPTION OF THE AREA

Topography and Drainage

The area straddles the height-of-land between the James Bay and the Lake St. Jean drainage basins. Slightly more than 50 per cent drains west and northwest through Némenjiche and Opawica rivers to the Chibougamau and Nottaway and eventually to James bay. The remainder of the area drains into Rohault and Bouteroue lakes and thence eastward and southeastward through Ducharme and Chamouchouane (Ashuapmuchuan) rivers to Lake St. Jean.

The relief generally is low (Plate 1-A). The highest hill, the site of fire tower No.77, stands between the northeastern end of Robert lake and the small lake to the north. It is about 350 feet above the level of Robert lake. Hills rise 250 feet above Rohault lake on the peninsula separating Gaudreau bay from the main part of the lake, and between Rohault and Bouteroue lakes.

A few elongated ridges in the northeastern part of the area rise about 200 feet above Mannard lake. The top of the highest ridge on the divide between Gabriel and Rohault lakes is about 200 feet above the surrounding plain.

Rohault lake, the largest water body in the area, is approximately 1,280 feet above mean sea-level and the elevations of Némenjiche, Gabriel, Robert, and Mannard lakes are about 1,295, 1,280, 1,300, and 1,310 feet respectively.

The lakes and streams are generally shallow, and their shapes and courses are usually controlled by the unconsolidated glacial or fluvioglacial deposits that cover much of the bedrock of the area. The western shore of Gabriel lake, the large peninsula of Rohault lake, and the shores of Bouteroue lake, are notable exceptions to the general rule.

Natural Resources

Flora

The area is well wooded except for a few open muskegs. A patch of burned ground west of Gabriel lake and south of Némenjiche lake is covered by new growth still too small and scattered to be of economic value.

Black spruce is by far the dominant tree and, although its butt diameter seldom exceeds one foot, it would make excellent pulpwood. The Canadian International Pulp and Paper Company owns the timber rights over the greater part of the area. Stands of medium-sized white spruce, balsam fir, birch, and aspen are common on the hills. Banksian pine, together with black and white spruce, grows in the sandy and clayey plains of the northern part of the area. Crooked and stunted cedars are common along the shores of most of the main lakes, and small to medium-sized tamaracks grow along most of the sluggish streams of the area.

Fauna

About 20 square miles of the eastern part of the area is included within the limits of the Chibougamau hunting and fishing reserve. Game, except bear, does not appear to be abundant in the area. Only five moose were seen during the summer of 1951.

Of the small fur-bearing animals, muskrat is the most abundant. Signs of otter, mink, and beaver were seen here and there. Rabbit, grouse, and duck are rather scarce. Numerous families of the common loon or great northern diver live on the islands of Rohault lake. Gulls and terns were seen on most of the larger lakes.

Pike and pickerel were caught in most of the lakes and streams; no trout were seen.

Climate, Soil, and Farming Possibilities

The minimum temperature recorded during June, July, and August of 1951 was 38°F.. Daily maxima of 80°F. were frequent. Precipitation was heavier than usual during the summer of 1951, and the morning relative humidity generally stood in the eighties.

A blanket of variable thickness of clayey soil covers most of the low parts of the area. This soil usually supports a thick

vegetation, and is probably suitable for selective farming.

GENERAL GEOLOGY

General Statement

All the consolidated rocks of the area are of Precambrian age. They include volcanic, tuffaceous, gabbroic and dioritic Keewatin-type rocks in the northernmost part of the area, and, to the south, a complex of paragneisses and orthogneisses generally considered as belonging to the Grenville sub-province. Numerous, generally small, Late-Precambrian basic dykes are present here and there.

Fine- to medium-grained gneissic rocks underlie about 85 per cent of the area. Formerly divided into two different groups, the Némenjiche series (Cooke, 1919, pp. 184-188) and the Grenville sub-province gneisses, which extend southeastward and eastward for many scores of miles, these rocks were found to belong to only one series and to be made up of two types of paragneisses intruded by foliated granitic material and pegmatite dykes. For the purpose of this report, the term "paragneiss" includes mainly gneisses derived from sedimentary, volcanic, and gabbroic-dioritic rocks, and the term "orthogneiss" includes the younger, dominantly acidic, intrusive gneisses. Actually, all of them are, strictly speaking, composite gneisses, and are assigned to the paragneiss or orthogneiss group according to the predominant characteristics.

Table of Formations

CENOZOIC	Recent and Pleistocene	Peat, sand, gravel, glacial till	
PRECAMBRIAN	Late-Precambrian	Basic dykes Keweenawan (?)	Garnetiferous coronite, olivine diabase, diabasic gabbro, lamprophyre
	Early-Precambrian	Orthogneisses	Hornblende-biotite orthogneiss, hornblende orthogneiss, biotite orthogneiss.
		Intrusive contact	
		Paragneisses	Garnetiferous biotite paragneiss, biotite paragneiss. Garnetiferous hornblende paragneiss, schist, and amphibolite, hornblende paragneiss, amphibolite, hornblende-biotite paragneiss.
		Keewatin-type rocks	Gabbro and diorite, schistose basalt, a little andesite and tuff.

Keewatin-type Rocks

Keewatin-type rocks underlie about 25 square miles in a belt ranging from one to 3.5 miles wide along the northern border of the area. This belt is the southern extension of the zone mapped by Imbault (1958) in the Queylus area to the north.

Volcanic and Tuffaceous Series

About two-thirds of the Keewatin-type rocks of the area are schistose, green, basaltic or andesitic lavas with, here and there, thin scattered interbeds of tuffaceous material. The lavas are well pillowed in places, especially near the northern boundary of the area, but the pillows are deformed or stretched to several times their original lengths. Ropy and amygdaloidal lavas are common. Carbonate and quartz are the main constituents of the amygdules. The deep weathering of these minerals has left a pitted surface, giving the flows a vesicular appearance.

The typical lava of the area is a fine-grained, dark green to green, schistose to sub-schistose rock in which the main minerals are hornblende (and/or actinolite) and plagioclase. The relative proportions of these two essential minerals may vary from 85 per cent mafic minerals to about 55 per cent plagioclase in some of the andesitic facies. Most of the lavas, however, contain about 80 per cent mafic minerals, generally hornblende, in places partly or totally hydrothermally altered to a pale green chlorite that gives the rock an andesitic appearance.

The granularity of the rock and the composition of its essential minerals vary with the grade and type of metamorphism to which the lavas have been subjected. Near the northern boundary of the area, the flows are hydrothermally altered, and show a felty texture. The actinolite and chlorite grains are ragged or acicular, and the plagioclase is either too saussuritized to be identifiable or completely replaced by carbonate, epidote, sericite, and quartz. Southward, near the garnetiferous hornblende paragneisses, the lavas become more or less schistose and some have a granoblastic texture. A deep bluish green, pleochroic, rhombohedral hornblende also becomes the dominant mafic mineral and small grains of clear, untwinned, anhedral plagioclase replace the saussuritized and carbonatized primary feldspar. The composition of this secondary plagioclase varies from An_{10} to An_{37} depending on the grade of metamorphism reached by the rocks. Porphyroblasts of garnet are present in some of the more recrystallized varieties of lava. Iron oxides generally form about five per cent of all the facies of the basic and intermediate flows.

Thin tuffaceous beds were encountered at scattered places within the lava flows. They are mafic to highly feldspathic and generally show a well-developed, fine stratification and a good schistosity. The tuffs are usually more hydrothermally altered than the adjacent flows.

Gabbroic and Dioritic Series

Intrusive rocks of basic to intermediate composition crop out abundantly in the zone of Keewatin-type formations, of which they make up at least one-third. Except for the large mass of this rock immediately north of Mannard lake, these exposures are generally scattered and of such small extent that the determination of the shapes of the bodies is mainly a matter of conjecture. The very few intrusive-volcanic contacts observed were found to be concordant with the structure of the volcanic rocks. Thus these intrusive rocks are inferred to be, as at numerous other places in the Temiscaming sub-province, tabular or lenticular and probably related to the lavas in age and origin.

The rocks of this series are characterized by a dark to light green colour and a massive, medium- to fine-grained, equigranular texture. The schistosity of the smaller bodies is parallel to that of the enclosing lavas and to the contacts. The composition varies from dioritic to gabbroic. The main mass north of Mannard lake is a medium-grained, massive to schistose, dioritic gabbro which, in places, is much altered and injected with quartz and carbonate. The rock is essentially made up of much saussuritized plagioclase (45 to 55 per cent), secondary and probably uralitic hornblende or actinolite (45 per cent), with titanite, leucoxene, magnetite, apatite, biotite, saussurite, carbonate, and quartz as accessory and secondary minerals.

A group of exposures of a medium- to fine-grained, basic intrusive rock near the northern boundary of the area seems to be part of a thin, sill-like mass of gabbro elongated in the direction of the strike of the adjacent volcanic flows. They may also represent a series of discontinuous parallel lenses of gabbro separated by areas underlain by volcanic rocks. The lenticular mass of intrusive rock of this series in the northeastern corner of the area is a medium-grained, very dark, partly recrystallized gabbro, and is in gradational contact with recrystallized volcanic flows along its southern edge.

Small exposures of rocks belonging to the gabbro-diorite series were also seen at a few places within the zone of garnetiferous hornblende paragneiss or amphibolite adjacent to the Keewatin-type rocks. Along the east shore of Mannard lake, a massive, medium-grained, altered pyroxenite is surrounded by amphibolite which grades into a garnetiferous variety. A similar mass was seen about half a mile southwest of mile post VIII on the east-west centre line of Rohault township. There, the rock is mainly a garnet-hornblende-feldspar gneiss or a garnetiferous amphibolite with, in places, remnants of a gabbro with dioritic

or anorthositic facies. These remnants have retained their original typical pitted-weathered surface and their massive, equigranular texture, despite a later growth of porphyroblasts of garnet within the rock, and the marked gneissic structure of the adjacent rock.

Paragneisses

The paragneisses of the area are characterized either by hornblende or by biotite. Despite much intermingling of the two types, it was possible to distinguish main areas of the two varieties.

Hornblende Paragneiss

A generally gneissic, garnetiferous, hornblende-feldspar rock underlies about one-third of the map-area. It crops out in a zone from 1 1/4 to 5 1/2 miles wide, extending across the northern part of the area immediately south of the belt of Keewatin-type rocks described above, and at the following places: in the west central part, south and west of the southern extremity of Némenjiche lake and west of the northern bay of Gabriel lake; north and northwest of Bouteroue lake; in the south central part, around the northern part of Robert lake; and in the southeastern corner.

The hornblende paragneiss is usually a medium- to fine-grained, slightly to well-foliated rock in which the gneissic structure is emphasized by the relative abundance of dark-green hornblende, white feldspar, and red garnet. In the northern part of the zone adjacent to the Keewatin-type formations, the rock is, in places, only slightly foliated and rather resembles a garnetiferous amphibolite in which there is a pronounced alignment of the hornblende needles. Banding is generally not a conspicuous feature in the hornblende paragneiss except where igneous injections are abundant.

Several thin sections of the hornblende paragneiss were studied under the microscope. A specimen collected from the northern part of the main zone of hornblende paragneiss adjacent to the Keewatin-type rocks shows, to the naked eye, a lineated, fine- to medium-grained, garnetiferous hornblende-feldspar rock in which the hornblende needles are well aligned and the pinkish-white feldspar is in very thin streaks parallel to the alignment of the amphibole needles and to the former planes of schistosity of the rock. The latter weathers dark green, and euhedral garnet porphyroblasts, up to 3.0 mm. in diameter, stand out in relief on the altered surface.

In a section cut at right angle to the gneissic structure, the above specimen rock appears as a fine-grained aggregate of hornblende (70 per cent), plagioclase (15 per cent), pink garnet (10 per cent), quartz (5 per cent), with leucoxene, titanite, zoisite, and apatite as accessory minerals. The hornblende is pleochroic from bluish-green to pale greenish-brown and the grains are well formed and cleaved. The plagioclase (An_{35}) is in small, anhedral grains which show little twinning and cleavage. The porphyroblasts of garnet contain inclusions of all the other minerals but most abundantly of quartz.

Along the easthern shore of Mannard lake, in the northern central part of the area, hydrothermal alteration has changed part of the hornblende into large feathery agglomerates of dark green chlorite and the rock has a spotty appearance. Here, the feldspar is a slightly saussuritized oligoclase (An_{27}).

A specimen of garnetiferous hornblende gneiss collected along the lower course of Robert river, near the southern boundary of the area, shows very fine streaks of plagioclase separated by well-lineated, dark green hornblende prisms. Under the microscope, the texture of the rock is seen to be granoblastic with a bluish-green hornblende making up about 40 per cent; oligoclase (An_{25}), 40 per cent; garnet, 15 per cent; biotite, 1 per cent; iron oxides, 4 per cent; with a little apatite and carbonate.

Some facies of the hornblende paragneiss of the southern part of the area contain more quartz, mostly a product of granitic injections. One specimen, collected from the north shore of Robert lake, has 45 per cent quartz, 45 per cent andesine (An_{32}), 10 per cent hornblende, and a few scattered porphyroblasts of garnet. Another, selected from the northern shore of Gabriel lake, has 25 per cent quartz; 35 per cent oligoclase (An_{29}); 25 per cent hornblende; 10 per cent garnet; and a little biotite, chlorite, titanite, apatite, and iron oxide. One specimen of hornblende gneiss interbedded with biotite gneiss on one of the islands in the main part of Rohault lake contains about 50 per cent andesine (An_{33}); 25 per cent hornblende; 15 per cent quartz; 5 per cent garnet; 5 per cent biotite; and some chlorite, carbonate, sericite, epidote, and iron oxide.

Biotite Paragneiss

A well-banded to slightly-lineated, medium- to fine-grained biotite-feldspar-quartz-garnet paragneiss makes up about 30

per cent of the bedrock in the area. It forms three irregular zones separated one from the other by granitic gneiss and hornblende paragneiss. The largest of these zones is about 1 3/4 miles wide at the western limit of the area, west of Némenjiche lake, and extends eastward and southward to include the eastern and part of the western shore of the northernmost extension of Gabriel lake, and the northern part of Rohault lake. At the entrance to Gaudreau bay, it is separated by a narrow zone of granite gneiss from another belt of biotite paragneiss cropping out from along the southeastern shore of the bay, southward, and then northeastward to Bouteroue lake, at the eastern boundary of the area. This latter belt is separated from an irregular zone of similar biotite paragneiss in the southeastern part of the map-area by a one-mile-wide belt of biotite orthogneiss. A small area of biotite paragneiss, a continuation of a belt in the Gamache area to the west, is also included in the belt of hornblende paragneiss south of Némenjiche lake.

The biotite paragneiss is a granoblastic rock in which, despite the metamorphism and the injections of granitic and pegmatitic material, the bedding has generally been preserved in the form of a conspicuous, consistent banding (Plate I-B). The thickness of the bands varies from a fraction of an inch to about three feet. On some of the small exposures, the rock is massive except for a slight lineation of the biotite grains. However, observations made on the arrangement of the minerals within the individual bands of some of the thickly banded rocks show a similar structure, and it is probable that the small exposures of apparently almost massive biotite paragneiss are parts of bands belonging to a thickly bedded series.

Inasmuch as the biotite paragneiss generally is banded its composition, texture, and colour are variable. The rock is dark green to almost pure white and commonly has a rusty-brown weathered surface although grey predominates in some facies. Some bands are almost exclusively made up of white feldspar, glassy quartz, and red garnet, whereas others are very rich in biotite. Idioblastic grains of red or purplish garnet, in places stressed and fractured, are generally present, and may make up to 25 per cent of the rock. Dark green hornblende, present in variable proportions in many of the biotite paragneisses, dominates in some bands near zones of hornblende paragneiss.

Along the eastern and western shores of Némenjiche lake and westward to the western boundary of the area, the biotite paragneiss is a medium- to fine-grained, generally well-banded rock, in which

quartzose and feldspathic igneous injections are common. Garnet is less abundant there than it is farther east and southeast, and is usually widely scattered in a small number of bands. Some exposures are mainly pegmatite, with scattered, small and partly digested inclusions of paragneiss.

In thin section, the biotite paragneiss of the western part of the area is a medium- to fine-grained granoblastic rock with well-aligned biotite blades. Quartz makes up about 30 per cent of the rock and is difficult to distinguish, under the microscope, from some of the oligoclase (An_{22}) which is anhedral to subhedral, very clear, untwinned, and usually little cleaved, and which makes up about 45 per cent of the gneiss. The biotite is pleochroic from greenish-brown to straw-yellow and is, in places, partly altered to chlorite and sericite. Epidote and a little allanite are associated with some of the biotite blades. A few grains of red garnet, iron oxide, and apatite are scattered throughout the rock. Tourmaline was seen at different places in the biotite paragneiss.

On the main part of Rohault lake, the biotite paragneiss is generally more garnetiferous although there are zones in which garnet is rare, probably owing to the abundance of pegmatitic and granitic injections. Interbanded hornblende and hornblende-biotite paragneisses are also relatively abundant (Plate II-A).

The microscope shows that the typical biotite paragneiss of the central part of the area is a medium-grained, granoblastic rock in which the main constituents are anhedral, small to medium-sized grains of quartz, 15 to 35 per cent; fresh, little twinned and cleaved oligoclase-andesine (An_{15} to An_{35}), 40 to 65 per cent; iron-rich, very pleochroic, dark- to light-brown biotite, 10 to 25 per cent; and red, generally fractured garnet, 5 to 20 per cent. The common accessory minerals are apatite, iron oxide, and titanite, and the products of alteration or injection include chlorite, epidote, zoisite, allanite, and sericite. A little hornblende accompanies biotite in two of the sections studied and zircon was found as small inclusions in the biotite flakes of another one. The porphyroblasts of garnet contain inclusions of all the other minerals of the rock but most abundantly of quartz and biotite. The latter mineral, together with green chlorite, has developed in fractures and cracks of the garnet grains. Very small rounded inclusions of quartz are present in the plagioclase of all the thin sections examined.

South of Gaudreau bay and on Bouteroue lake, the biotite paragneiss is similar to that on the main part of Rohault lake (central part of the area), except for the greater abundance of granitic and pegmatitic injections. Along the southeastern shore of Bouteroue lake, red garnet is very abundant in some facies of a well-banded paragneiss, the composition of which is variable.

Similar features characterize the biotite paragneiss of the southeastern corner of the area, but a hornblendic facies seems to be more abundant there. Pegmatitic and granitic injections are also very widespread and one hill, slightly less than a mile north of the northeastern-most extension of Robert lake, has a core of pegmatite intruding the surrounding biotite paragneiss.

One specimen collected from exposures on the small islands in the central part of Robert lake shows a medium-grained granoblastic rock made up of quartz in irregular, interlocking grains, 30 per cent; fresh oligoclase-andesine, 40 per cent; iron-rich biotite, 20 per cent; mauve garnet, 5 per cent; and iron oxide, 5 per cent. Another specimen collected from the western shore of the lake adjacent to the eastern boundary of the area, about 3 1/2 miles north of the southeastern corner, contains 30 per cent quartz; 40 per cent oligoclase (An_{27}); 12 per cent biotite; 8 per cent bluish-green hornblende; with a little epidote, apatite, and iron oxide. Garnet is absent in this specimen but makes up about 5 per cent of the otherwise similar adjacent paragneiss.

Orthogneisses

About 25 per cent of the rock of the present area consists of irregular masses of a well-foliated to slightly lineated, biotite-hornblende-feldspar-quartz orthogneiss. The largest mass of this type of rock is in the southwestern and central parts of the area. An apparently isolated mass of similar rock crops out along the east shore of Gaudreau bay. The northern parts of two large bodies cropping out south of the present area are represented by a limited number of exposures towards the southern boundary of the map-area.

The orthogneiss is dominantly fine- to medium-grained and grey to pink. It contains abundant injections of pegmatite and numerous, more or less digested, lenses or discontinuous bands of amphibolite and paragneiss. The fine-grained facies is generally richer in biotite than the medium-grained variety; in the latter, hornblende may be the dominant or the only mafic mineral.

Under the microscope, the rock is seen to be a lineated or foliated, granitoid aggregate of stressed quartz, 15 to 35 per cent but ordinarily about 30 per cent; well-cleaved and twinned, commonly saussuritized, oligoclase (An_{12} to An_{25}), 50 to 65 per cent; microcline, 0-10 per cent; biotite and/or hornblende, 5 to 15 per cent; with titanite, apatite, iron oxide, zircon, epidote and allanite, chlorite, sericite, saussurite, and carbonate as accessory and secondary minerals. The microcline, present in about half of the specimens studied, corrodes and includes all the other minerals. It forms, in places, pink to greyish phenocrysts up to three inches long, which are very similar to the feldspar of the later pegmatites. The oligoclase is almost pure white on weathered surfaces and creamy-white on fresh surfaces. The biotite is generally in flakes or laths, pleochroic from brownish-green to straw yellow. The hornblende of one section is somewhat sodic with a strong pleochroism from dark bluish green to green. Some sections have large flakes of white mica, probably muscovite. Many of the pegmatites of the area contain 'books' of this mineral.

The fine-grained biotitic facies of the rock strongly resembles some non-garnetiferous massive facies of the biotite paragneiss. However, the more calcic and fresher plagioclase, the iron-rich biotite, the absence of potassic feldspar, and the greater evenness of granularity of the paragneiss are good criteria to distinguish the two varieties of rock.

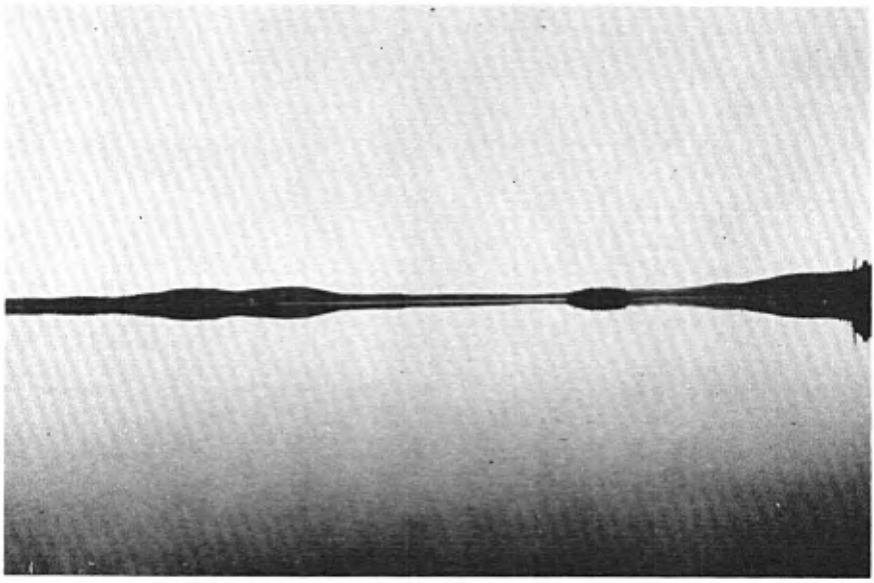
Particular attention was paid in the field to the body of acidic intrusive rock near the northern part of Gabriel lake, which is classified as a granite on Map 397 A of the Geological Survey of Canada (Mawdsley and Norman, 1938). No essential difference in composition, appearance, structure, and texture was found between that intrusive and the orthogneiss of the remainder of the area. Consequently, all the acidic intrusive rocks of the area are classified as orthogneiss.

Basic Dykes

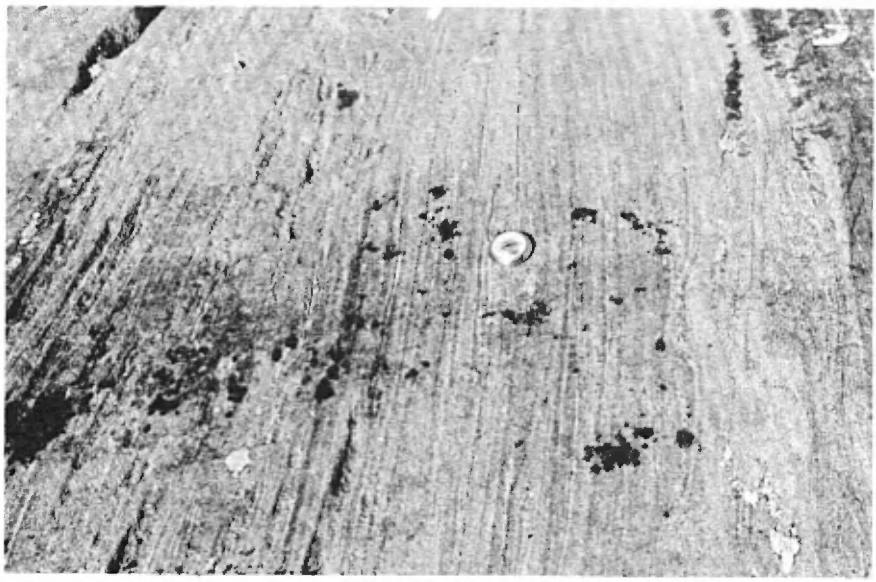
Numerous fresh to much altered basic dykes crop out at various places throughout the area. They cut the Keewatin-type greenstones, the paragneisses and the orthogneisses, and they include various types of diabase, coronite, and lamprophyre. The dykes are generally less than 100 feet wide. The widest, 500 feet or more, crops out west of Némenjiche lake.

In the western and northern parts of the area, the dykes are fresh or only slightly altered diabase. To the east and south, the

PLATE I



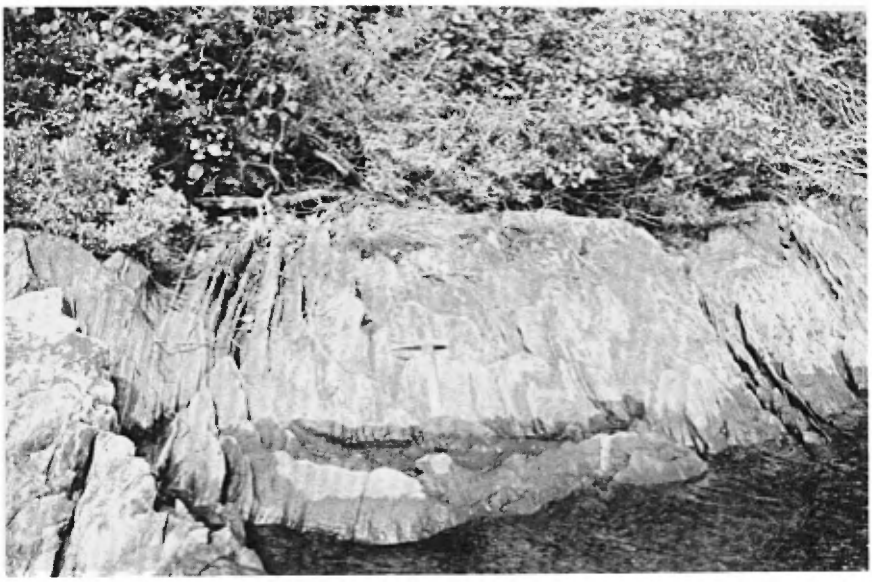
A.—Northern part of Rohault lake, from the southwestern tip of the peninsula separating Gaudreau bay from the main part of the lake.



B.—Thinly banded garneliferous biotite paragneiss. Central part of Robert lake.

PLATE II

A.—Banded garnetiferous biotite-hornblende paragneiss. Island just west of the southwestern tip of the peninsula separating Gaudreau bay from the main part of Rohault lake.



B.—Drag folded biotite paragneiss. Southeastern shore of Bouteroue lake.

dykes are generally garnetiferous, altered, basic intrusive rocks. These latter contain coronas of various alteration products around cores of primary minerals which still show, in many cases, traces of an ophitic arrangement. The exposures of garnetiferous coronites near the western boundary of the map-area, at and about one mile north of the outlet of Gabriel lake, and part of the large dyke west of Némenjiche lake are exceptions to the general rule of distribution.

The typical fresh diabase is almost black, with a rusty, pitted weathered surface. The ophitic texture can easily be seen in the medium- to fine-grained varieties but is less obvious in the coarse-grained types. The central part of the large dyke west of Némenjiche lake represents the typical diabase of the area. The rock is a medium-grained, very fresh, dark diabase in which the ophitic texture is easily visible both on fresh and weathered surfaces and in thin section. A well-twinned, purplish grey, bladed labradorite (An_{60}) makes up approximately 50 per cent of the rock; black olivine, 20 per cent; green diopside, 20 per cent; dark-brown biotite, 2 per cent; magnetite, 4 per cent; and serpentine, 4 per cent.

On the island in the small lake about half a mile west of the southern part of Némenjiche lake, the diabase is fresh, medium-grained, and consists of labradorite (An_{60}), 60 per cent; hypersthene, 15 per cent; pigeonite, 15 per cent; uralite, 5 per cent; biotite, 3 per cent; magnetite, 2 per cent; and a little carbonate. The diabase exposed on the east and west sides of Gabriel lake has a similar appearance.

In all the other exposures of late basic intrusive rocks, the diabasic texture has been partly or completely obliterated by metamorphism and metasomatism. The rocks are garnetiferous coronites, typified by the dyke on the eastern shore of the lake about 3 miles north of the southeastern corner of the map-area. This rock resembles the olivine diabase described above except for the presence of garnet and an abundant pale-green, apparently interstitial mineral. It appears to be granular, and the weathered surface is pitted. In thin section, the texture is seen to be slightly ophitic despite the alteration of the constituent minerals, and some of the plagioclase is still in blades although these are deeply indented in places by secondary minerals. The plagioclase, andesine (An_{40}), is much clouded by very fine iron oxide and thick networks of very small needles of sericite. It also contains abundant very small, colourless inclusions that may indicate reheating after consolidation. It is probable that the

original plagioclase was more abundant than the andesine (25 per cent of the rock), and part of it has changed to garnet and saussurite. Altered and fractured anhedral olivine makes up about 15 per cent of the rock and is surrounded by relatively thick (1.0 to 2.0 mm.) coronas of fine, anhedral, radially arranged grains of hypersthene which in turn are surrounded by thin discontinuous rims of pale-green, pleochroic serpentine, and by a third, thicker rim of generally small grains of red garnet. In places, the olivine has been completely replaced by hypersthene.

Diopside makes up about 5 per cent of the rock; it is also somewhat altered and, when the adjacent mineral is plagioclase, is surrounded by a thin corona of garnet. There are no reaction rims at the contacts between grains of diopside and olivine. Dark brown, very pleochroic, iron-rich biotite makes up about 5 per cent of the coronite. It is commonly observed in a garnetiferous reaction rim near plagioclase and is itself a late stage reaction mineral. It also occurs in fine grains or veinlets in cracks and along cleavage planes of diopside and olivine.

Secondary hypersthene constitutes about 30 per cent of the rock; garnet, about 20 per cent; serpentine, about 2 per cent; uralite, chlorite, and sericite, about one per cent each. The rock also contains a few grains of apatite, generally associated with biotite, a little carbonate, and a few small rounded areas of sodic feldspar, probably albite or sodic oligoclase, which apparently is a product of alteration of the primary plagioclase.

Narrow lamprophyre dykes are relatively abundant in the area. Some of them, such as those along the western shore of the southern part of Gabriel lake, are definitely associated with the coarse-grained, diabasic variety of basic dykes and it is quite possible that all the basic dykes are magmatically related. The lamprophyres are black, very fine-grained porphyritic rocks in which the phenocrysts are generally pyroxenes, amphiboles, or biotite. Iron oxides are abundant in them.

Glacial Geology

Although the area was covered by Pleistocene ice sheets their passage left relatively few destructive or constructive features. Glacial striae and a few chatter marks can be seen at various places along the shores and on the islands of the many lakes of the area.

They indicate that the last general movement of the ice was S.10°W. to south.

Glacial till is abundant throughout the area and is thick enough to support a good growth of various evergreen and deciduous trees. Most of the larger boulders of the till are of local origin and it is believed safe to assume that over 80 per cent of the big erratics were derived from bedrock less than half a mile away.

A few, low, drumlinoid ridges were seen, the largest being along the shores of the northernmost extensions of Gaudreau bay, near the eastern boundary of the map-area.

Fluvioglacial deposits include some relatively low, north-south trending eskers, generally made up of coarse gravel to fine clayey sand. The longest of these are: the one extending between the southern shore of Rohault lake and Robert lake, in the southern part of the area; and the one following the middle course of Némenjiche river, near the northwestern corner. A few sand plains were also seen, the most extensive being along Némenjiche river. No varved clays were seen.

Sandy beaches are relatively abundant along the shores of the main lakes. The sand on some of the beaches along the south-eastern shore of Bouteroue lake is reddish owing to its large proportion of garnet.

Age Relationships and Correlation

As stated in the introduction, the Rohault area is located along the postulated contact between the Temiscaming and Grenville sub-provinces. A relatively narrow band in the northern part is underlain by rocks possessing all the characteristic features of the Keewatin-type assemblage of the Temiscaming sub-province. To the south, and underlying much the greater part of the area, are gneisses similar to some of the rocks that, farther to the south and southeast, have been described as belonging to the Grenville sub-province.

Geologists disagree on the nature of the contact between the two sub-provinces. Some claim that it is marked by a fault or a zone of faults; others believe that it is gradational. In the Bignell area (Gilbert, 1958), it is characterized by both faulting and gradation. In the present area, the passage from Keewatin-type greenstones and gabbro-diorite into garnetiferous hornblende paragneiss is gradational.

The contact is very indefinite and seems to follow a moderately wavy, more or less eastwest line except in the northeast corner where it trends northeast. In the western third of the area, the contact is covered by a thick blanket of unconsolidated deposits. The schistose Keewatin-type rocks become more and more recrystallized southward, and the schistose structure becomes more and more gneissic. Likewise, garnet, which is widely scattered in the schistose rocks of the vicinity of the contact, becomes more abundant southward until the rock becomes a hornblende-feldspar-garnet gneiss in which a compositional banding is commonly conspicuous. Thin sections of the transitional rocks also show the change in texture from schistose to granular and gneissic, and the recrystallization of the feldspar and amphibole.

Also, relics of volcanic and gabbroic rock are present in the zone of hornblende paragneiss adjacent to the Keewatin-type rocks. The main belt of biotite paragneiss in the northern part of the area is along the strike of a belt of sedimentary rocks farther to the west between Caopatina and Surprise lakes (Mawdsley and Norman, 1938) of which it could easily be the more metamorphosed equivalent.

The diabase and coronite dykes of the area are also of considerable interest in the study of the age relationships of the different rocks in the area. The diabases are identical in every way to rocks of Keweenawan age in the Temiscaming sub-province. The large basic dyke west of Némenjiche lake has, as stated above, a core of fresh and massive olivine diabase grading outward into a garnetiferous coronite that, in the border facies of the dyke, passes into a garnetiferous, lineated, amphibole-feldspar rock similar to some facies of the adjacent hornblende paragneiss. It would seem that this large dyke, which is barely 2 miles from the Keewatin-type greenstones and is in a zone of biotite paragneiss of low-grade metamorphism, was more resistant to the metamorphism which caused the change of the schistose greenstone into hornblende or biotite paragneiss. Farther to the southeast and east (deeper into the area of gneissic rocks), the metamorphism of the diabasic rocks was more complete and the rock was wholly changed to a garnetiferous coronite.

On the other hand, if the diabasic dykes of this area and those of the adjacent areas to the north and northwest be interpreted as Keweenawan in age, it would imply that the metamorphism of the Keewatin-type rocks of the area into paragneisses took place after, or during the later part of, the Keweenawan. Some small diabasic dykes of the area are fresher than the others and seem to have been introduced after the formation of the gneisses, but, apparently, most were emplaced before

the metamorphism of the schistose Keewatin-type rocks into paragneisses.

STRUCTURAL GEOLOGY

Folds

The Keewatin-type volcanic, tuffaceous, and gabbroic rocks of the northern part of the area, together with the northern section of the hornblende paragneiss zone just to the south, have a general east-west trend similar to that of the adjacent area to the north (Imbault, 1958). Farther south, the structural trend of the gneisses is much more variable (see accompanying map).

In the Keewatin-type rocks, the dip of the schistosity is generally steeply south and, as far as could be ascertained, the schistosity is parallel to the strike of the flows and of the tuffaceous beds. Although pillows are present, especially near the northern limit of the area, they are all much too disturbed to serve as an indication of the direction in which the flows face.

The strike of the gneissic structure of the paragneisses is generally concordant with the outlines of the individual rock masses. Exceptions to that rule are, however, abundant in the orthogneisses.

Numerous drag folds were seen in the area but most of them are very small and their axes commonly have inconsistent and variable trends and plunges within short distances. However, in the Keewatin-type rocks, most drag folds trend parallel to the schistosity of the formations and plunge almost vertically. Some possibly suggest the existence of an anticlinal axis about half a mile south of the northern boundary of the map-area.

A few larger and better formed drag folds were seen at three places in the paragneiss of the area. The largest occurs along the southeastern shore of Bouteroue lake, half a mile west of the eastern boundary of the map-area (Plate II-B). It is about 25 feet wide, and its axis strikes N.40°E. and plunges 35° northeast. A smaller drag fold, located on the northern tip of the island, between 1,200 and 2,000 feet to the northwest, has its axis parallel to that of the fold described above but its plunge is reverse, i.e., 25° to the southwest.

A series of well-formed drag folds in banded biotite and hornblende paragneisses along the west shore of Gaudreau bay suggests that the gneisses of the peninsula between the bay and the main part

of Rohault lake form an anticlinal fold plunging towards the southeast. Elsewhere in the gneisses, the position of the fold axes can only be conjectured from the shapes of the different areas of rocks as they appear on the accompanying map.

Shear Zones and Faults

Shear zones are abundant in the northern half of the area. They are less abundant and more local in the southern part.

The shears in the Keewatin-type rocks and in the hornblende paragneisses of the northern part of the area generally strike east, although some strike almost northeast and a few slightly south of east. The strikes of the shears in the gneissic rock are much more variable.

The largest and most continuous shears are exposed along the shores of Mannard lake and on the Chibougamau Explorers and Noranda Mines properties, near the northern boundary of the area. They probably represent a large east-west break which extends farther to the west into Fancamp and Gamache townships where it has been disclosed by diamond drilling. The exposed shears along that break have a width up to more than 150 feet in the present area, on the Noranda Mines property (see below). Most of them are parallel to the local trend of the schistosity or the gneissic structure of the country rock, although some may cut them at an angle of as much as 45°.

A few small oblique faults were seen in the gneissic rocks of the area and one is reported on the property of Chibougamau Explorers, Limited. The oblique or cross faults generally trend northeasterly.

ECONOMIC GEOLOGY

General Statement

The northern part of the Rohault area has been the site of considerable prospecting activity since the discoveries of 1949 and 1950 in the Queylus area to the north. This activity has resulted in the staking of most of the northwestern corner of the map-area. An important gold-copper deposit was discovered close to the western shore of Norhart lake.

Several mineralized zones were seen during the summer of 1951. Most of these are small and are characterized by an intense

carbonatization and some silicification of the rock together with a dissemination of pyrite and a few copper-bearing minerals.

Large carbonate zones are abundant in the sheared hornblende paragneisses of the shores of Mannard lake, and pyrite is commonly associated with the carbonate. Malachite and chalcopyrite occur together with pyrite, carbonate, and quartz in rock exposures along the sandy beaches of the north shore of the lake, and pyrite concentrations were seen on and just inland from the west shore of the southern part of the lake.

Pyrite, massive and disseminated, was also observed in carbonated and silicified paragneiss along the shores of Némenjiche lake and of the small lake to the southwest.

The most active companies in the area at the time of the writer's visit were Chibougamau Explorers, Limited, Noranda Mines, Limited, and Conwest Exploration Company, Limited.

Description of Properties

Chibougamau Explorers Limited (1)[z]

This company was formed in August 1950 to examine and develop a group of 20 claims in the southern part of La Dauversière township. These claims are numbered C. 43777, cls. 1 to 5; C. 43778, cls. 1 to 5; C. 43779, cls. 1 to 5; and C.43780, cls. 1 to 5. The main showing (No. 1) of the property is located in C. 43778, cl. 2, and consists of narrow, quartz-filled, gold-bearing cross fractures in schistose gabbro and diorite.

During the winter of 1950-1951, the company purchased the Austman Syndicate group of 15 claims located in the northwestern corner of Rohault township and adjacent to the south of the ones it already owned. These claims are numbered C. 43794, cls. 1 to 5; C. 43795, cls. 1 to 5; and C. 43796, cls. 1 to 5. A camp was set up on the west shore of Norhart lake, 23 miles south of the Caché Lake air base and about 10 miles southwest of mile post No. 118 of the St.Félicien-Chibougamau highway.

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[z]Numbers in brackets refer to showings on the accompanying map.

Following the surface trenching and sampling of showing No. 3, in C. 43796, cl. 1, in Rohault township, and an electrical geophysical survey, a systematic diamond drilling programme was started in April, 1951.

Thirty-one holes totalling 12,575.4 feet were put down on the property up to October 10th, 1951. Most of these holes are shallow (not exceeding 400 feet) and are collared at 50-foot intervals in the vicinity of showing No. 3, near the western shore of Norhart lake. They have outlined a strong shear zone in altered volcanic flow and tuff, varying in width from 8 to 40 feet and containing quartz lenses and stringers with pyrite, pyrrhotite, chalcopyrite, and gold. The zone strikes N. 80° W. and dips about 85° to the south. The volcanic rocks are intruded by numerous altered diorite-gabbro-pyroxenite, syenite, and feldspar porphyry dykes. The zone material, together with the wall rock, is cut, here and there, by narrow, massive, and fresh lamprophyre dykes generally trending close to northeast.

The hydrothermal alteration of the wall rock is considerable and a zone of silicified material generally borders the quartz lenses and veins. Chlorite and biotite are the dominant secondary mafic minerals, and spots of the latter mineral are conspicuous on the weathered surface of some of the gabbro-diorite of showing No. 1. Sulphide replacement accompanied the hydrothermal alteration of the wall rock.

The short holes put down by the company intersected the vein over a length of about 1,500 feet and a vertical depth of 120 to 240 feet, with the zone still open at both ends. Difficulties, due to flattening of the dip of the holes, were encountered in the drilling of four long holes put down to explore the mineralized zone at depth.

The drilling had outlined, at the end of October 1951, about 720 tons of ore per vertical foot for an explored length of about 1,500 feet. The grade of the ore is about 0.42 oz. of gold (cut grade) and 0.82 per cent copper.

The company has initiated a drilling programme designed to test ore conditions on a 100-foot grid pattern to a vertical depth of 500 feet. This will be followed by a 200-foot pattern to a vertical depth of 1,000 feet.

R. Storen (since deceased) was in charge of the field work at the time of the writer's visit and S.E. Malouf was the consulting

geologist for the company.

Noranda Mines Limited (2)

This company held in 1951 a group of 30 claims straddling the La Dauversière-Rohault township line, about 2 1/2 miles east of Chibougamau Explorers, Limited. The claims are numbered C. 43785, cls. 1 to 5; C. 43786, cls. 1 to 5; C. 43787, cls. 1 to 5; C. 42929, cls. 1 to 5; C. 42930, cls. 1 to 5; and C. 42931, cls. 1 to 5.

The rocks underlying the property consist of schistose basalts intruded by massive to schistose diorite and gabbro. A persistent strong shear zone, trending about N. 35° E., crosses the northern part of the property.

Although a ground magnetometer geophysical survey of the entire property was made during the summer of 1951, most of the detailed exploration and all the trenching have so far been concentrated in the northern part. The main trenching was done on C. 43785, cls. 1 and 4, located respectively south and north of the middle of the three small lakes lying about 3,500 feet north of mile post No. 4 of the La Dauversière-Rohault township line.

Four trenches, trending between N.5°E. and N.25°E., were excavated from 150 to 450 feet north of the lake referred to above, in the southern part of claim 1, C. 43785. The first trench to the south, 60 feet long and 8 feet wide, shows a slightly fractured, but otherwise massive, medium-grained gabbro containing disseminated pyrite and small lenses and stringers of white quartz. One hundred feet northwest, another trench, trending N. 5°E., 75 feet long and with a maximum width of 45 feet, exposes along its southern edge about 10 feet of medium-grained gabbro. To the north, there is sheared greenstone, possibly intrusive, and a vein of white quartz, 15 feet long and 4 feet wide, accompanied by a swarm of small lenses of quartz up to one foot long. The vein and the lenses of quartz and the shearing are parallel, with strike of S.65°E. and dip 75° northeast. The quartz is sparsely mineralized with pyrite, and a grab sample of it, taken by the writer, assayed 0.271 oz. of gold per ton. The other trenches are in boulder clay.

South of the small lake in the northeastern part of claim 4, C. 43785, a picket line, trending S. 30°W., has been cut to follow another shear zone, and about 20 trenches have been excavated to explore the zone. The main trench of this group, located close to the northern

boundary of the claim, is 310 feet long and trends N.60°W. It exposes a slightly schistose to much sheared, basic to intermediate lava intruded by masses of medium- to fine-grained gabbro. This shear zone is about 60 feet wide and contains scattered pyrite and chalcopyrite with a little gold. About 200 feet farther to the southwest, a slightly shorter trench parallel to the one mentioned above, exposes about 150 feet of sheared greenstone, apparently of volcanic origin, which is somewhat carbonatized and contains small quartz veins. A two-foot length of this zone is much mineralized with pyrite and, although reported to carry up to half an ounce of gold per ton, a sample taken by the writer yielded only low values.

In the numerous other trenches towards the southwest in which the main shear zone is exposed, the pyrite mineralization is very scattered and the value low.

Conwest Exploration Company, Limited (3) (Later, Meston Lake Mines, Limited)

The property of this company, staked by A. Meston, consists of a group of 20 claims in Gamache township, the eastern boundary of the group being about 800 feet within the limits of the Rohault area. As the main showing is barely 800 feet west of the western boundary of the present area, it is described here.

The claims are numbered C. 45392, cls. 1 to 5; C. 45390, cls. 1 to 5; G. 3022, cls. 1 to 5; and G. 3023, cls. 1 to 5. The property is joined to Norhart lake by a tractor road slightly over three miles long. The company camp is located on the northeast shore of Meston lake, just off the western boundary of the map-area.

The main showing of the property is on a small point on the north shore of Meston lake, in claim 4, C. 45390. It consists of a medium- to coarse-grained, altered, sericite granite exposed by a trench, 75 feet long, 15 feet wide, and trending N. 35° E. The granite contains three sets of fractures trending respectively S. 80° E., N. 45° E., and north. Quartz-tourmaline veins with some pyrite and a little free gold fill the fractures. The gold seems to occur more commonly in association with the tourmaline, but it has also been found in the milky quartz. Fine pyrite is also scattered in the granite.

About 1,000 feet of diamond drilling was done on the main showing of the property by Harricana Gold Mines, Incorporated, which had optioned the group during the summer of 1951. The drill holes were fanned out from the mineralized exposure of granite on the shore, but the results were inconclusive because of the irregular distribution of the gold and the fractured nature of the granite.

Recommendations

Drilling results on the Adnor Mines property immediately west of the ground of Chibougamau Explorers suggest that the mineralization found on the latter property extends for some distance westward. It possibly also continues eastward, and the eastern part of the zone of Keewatin-type rocks of the area should be investigated more carefully. Numerous small quartz-carbonate veins, many of them mineralized with pyrite, were seen in that part of the area.

The paragneisses in the vicinity of Mannard and Némenjiche lakes and in the regions to the west and southwest of these lakes also deserve careful examination. The presence of large amounts of mineralized carbonate and quartz in these rocks indicates that hydrothermal solutions were as active in some of the paragneisses as they were in the greenstones of the northern part of the area.

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APPENDIX to G.R. 86

ECONOMIC GEOLOGY

by

J.-E. Gilbert

The most important development which took place between the date at which the field work on which this report is based and its publication was the successful development of the Chibougamau Explorers Ltd. property, on Norhart lake, along the boundary between La Dauversière and Rohault townships. Extensive surface diamond drilling, the sinking of a 595-foot shaft, which was completed on December 1st, 1952, and underground development work was done between 1951 and 1954 by Chibougamau Explorers Co.

Anacon Lead Mines Ltd. took control of Chibougamau Explorers at the end of 1954 and, after shaft deepening and further development work, the ore reserves above the 900-foot horizon were estimated on February 1956 (date at which the 500-ton-daily-capacity mill and concentrating plant started operating) at 546,725 tons averaging 0.30 ounce of gold per ton and 0.93 per cent copper. At the end of 1958, some 99,500 ounces of gold, 73,500 ounces of silver and 4 1/2 million pounds of copper had been produced and ore reserves above the 1,200-foot level were estimated on November 1st, 1958, at 218,000 tons averaging 0.205 ounce of gold per ton and 0.41 per cent copper. The company is currently considering a shaft-deepening programme.

Exploration work including geological and geophysical surveys was also undertaken during the same period by about 15 other companies, mostly along the belt of Keewatin-type rock in the northern part of the map-area. Some, such as New-Jersey Zinc Exploration Co. (Canada) Ltd., Rohault Mines Ltd., Noranda Mines Ltd., Montgomery Mining Co. Ltd., and others, did fairly large amounts of diamond drilling in which generally scattered mineralization of sulphides and of precious metals was encountered.

Quebec, April 29, 1959.

ALPHABETICAL INDEX